Chapter 5

Analysis of New Energy Outlook of BAU

1. Modelling Assumptions

1.1. GDP and population

In preparing energy demand forecasting for 2050, Cambodia's GDP is assumed to have an AAGR of 6.7%. The population will grow steadily with an AAGR of 1.5%, resulting in an AAGR of GDP per capita of 5.1% (Table 5.1). Compared to ERIA's EAS Energy Outlook 2019–2020, including Cambodia, the GDP assumption was 6.4% in 2017–2050, so this GDP assumption is higher than the previous outlook. On the other hand, the population assumption was the same as 1.5% in 2017–2050.

Table 5.1. Updated Energy Information

Year	2019	2020	2030	2040	2050	AAGR (%) 2019–2050
GDP (2010 US$ billion)	21	22	43	82	154	6.7
Population (million)	16.5	16.7	19.4	22.5	26.2	1.5
GDP/capita (US$/person)	1,300	1,300	2,200	3,600	5,900	5.1

Source: Authors' calculation.

1.2. Electricity generation

Regarding future electricity supply, LNG is expected to dominate Cambodia's fuel mix in 2050, followed by coal. According to the country's Power Development Plan (PDP) 2020–2030, Cambodia will have a total additional installed electricity generation capacity of 24,384 MW. The main contributors will be LNG (9,600 MW); hydro (5,927 MW); and coal (5,140 MW) in 2050 (Table 5.2).

Table 5.2. BAU Install Capacity

| Technology	Installed Capacity (MW)						
	2020	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
HFO_PP_EDC	400	400	400	400	400	400	400
Wind	-	80	180	280	380	480	580
Natural Gas	-	-	3,600	4,800	6,000	7,200	9,600
Solar	75	525	1,725	1,925	2,125	2,325	2,525
Biomass	29	29	29	29	29	29	29
Hydro	2,103	2,103	4,727	4,727	5,927	5,927	5,927
HFO/Diesel	281	183	183	183	183	183	183
Coal-Fired Power Plant	1,000	3,390	5,140	5,140	5,140	5,140	5,140
Total	3,888	6,710	15,984	17,484	20,194	21,684	24,384

Source: Author's calculation.

2.   Outlook Results of Business-as-Usual Scenario

2.1.   Primary energy consumption

Cambodia's primary energy consumption, or primary energy supply, grew at an average annual rate of 5.4% from 2019 to 2050. Primary energy consumption will increase from 7.2 Mtoe in 2019 to around 37 Mtoe in 2050, slightly faster than final energy demand, from almost 5 Mtoe in 2019 to 25 Mtoe in 2050 (Figure 5.1).

Figure 5.1. Primary Energy Consumption
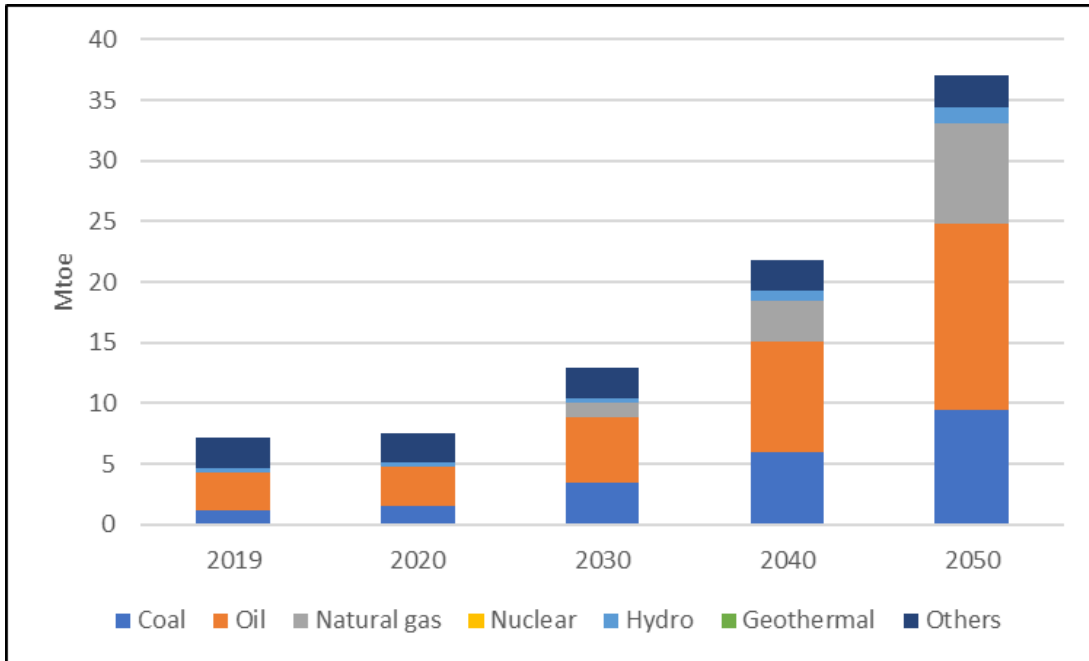
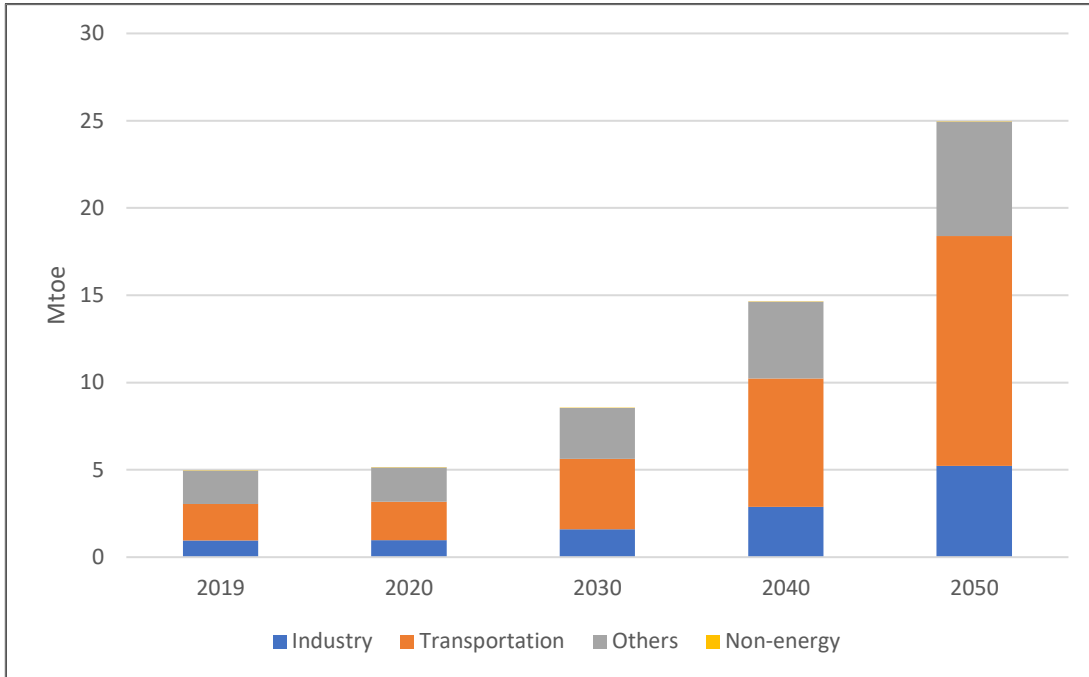Source: Authors' calculation.

The fastest growth is expected in natural gas, increasing at 16.6% yearly, from 0.24 Mtoe in 2027 to 8.17 Mtoe in 2050. This is followed by solar and wind, growing at an average rate of 12.5% per year between 2019 and 2050, and coal and oil at 6.8% and 5.3% per year, respectively, in the same period.

Oil plays a major role in the country's primary energy mix, with a share reaching 43.4% in 2000. Although still dominant, the share of oil products in the primary energy mix will slightly decrease to almost 42% by 2050. Coal share in the 2050 energy mix will be around 25%, while natural gas will reach 22%. The remaining shares will be those of biomass (6%), hydropower (3.6%), renewable (0.8%), and electricity import (0.6%).

2.2. Final energy demand

Cambodia's final energy demand will grow at an average annual rate of 5.3% from 2019 to 2050. Final energy demand by sector increased from around 5 Mtoe in 2019 to almost 25 Mtoe in 2050, as earlier mentioned (Figure 5.2).

**Figure 5.2. Final Energy Demand by Sector**

Source: Authors' calculation.

The strongest growth in demand is projected to occur in the industry sector, which will increase at an annual average rate of 6.2% over 2019–2050, or 5.9 times from 0.72 Mtoe in 2019 to 5.04 Mtoe in 2050. In addition, the transport sector is projected to grow at an annual rate of 5.6% or 4.78 times from 1.75 Mtoe in 2019 to 10.12 Mtoe in 2050. This is followed by the other sector at 4.4%, from 1.81 Mtoe in 2019 to 7.15 Mtoe in 2050, respectively (Figure 5.2).

Coal is projected to exhibit the fastest growth in final energy demand, growing at 10.3% per year or 22.06 times from 0.08 Mtoe in 2019 to 1.74 Mtoe in 2050. Electricity is projected to have the second-highest growth rate of 7.6% per year. or 9.35 times from 0.74 Mtoe in 2019 to 7.7 Mtoe in 2050. Oil is projected to have the third-highest growth rate of 5.1% per year. or 3.97 times from 2.38 Mtoe in 2019 to 11.86 Mtoe in 2050. Oil and electricity demand share in 2050 will be significantly large, so the energy saving from both fuels is crucial (Figure 5.3).

Figure 5.3. Final Energy Demand by Fuel
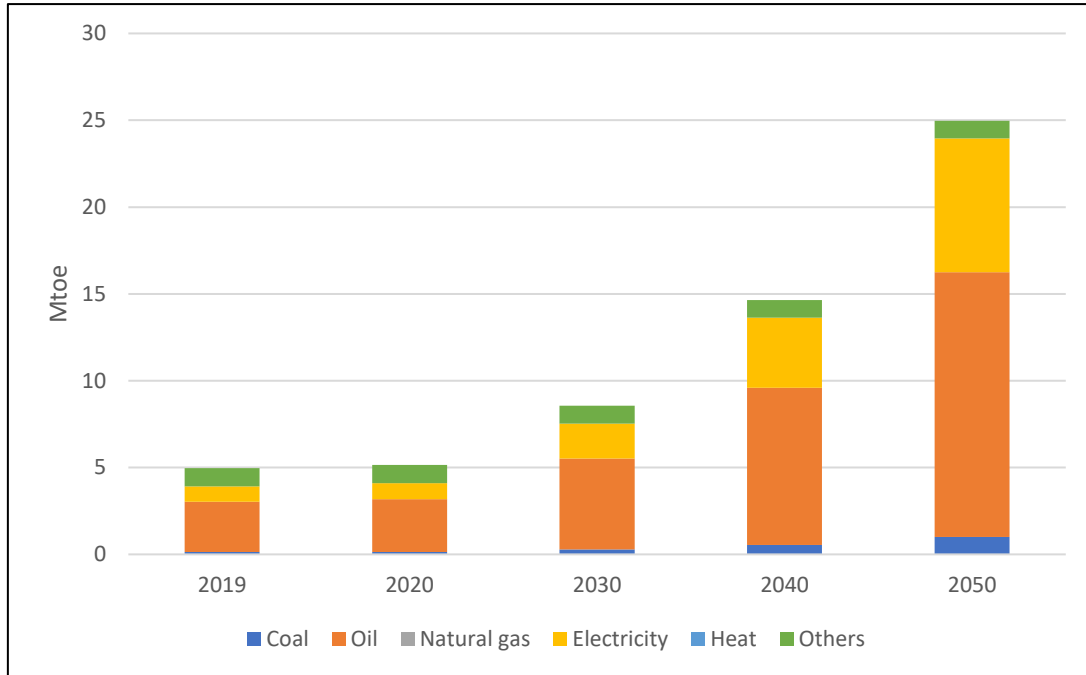
2.3. Electricity generation

Electricity generation will grow by 8.1% per year from 9 TWh in 2019 to almost 100 TWh in 2050 due to the rapid rise in electricity demand. From 2030 to 2050, electricity generation in Cambodia will come from three main sources. These are the LNG power plants having an increasing share from 28% to 50%; coal-fired power plants, from 46% dropping to 30%; and hydro, from 19% dropping to 16%.

Other power generation sources (such as biomass, solar, and wind) will have only a 4% share in 2050. These other sources will experience the fastest growth at 10.2% yearly over 2019–2050. Natural gas power generation will increase at an average annual rate of 16.6% in 2027–2050, while coal-fired and hydropower generation will increase by 6.8% and 4.4%, respectively, in 2019–2050 (Figure 5.4). Due to high fuel costs, generation from oil-fired power plants will decrease by -0.8%.

Figure 5.4. Power Generation by Fuel
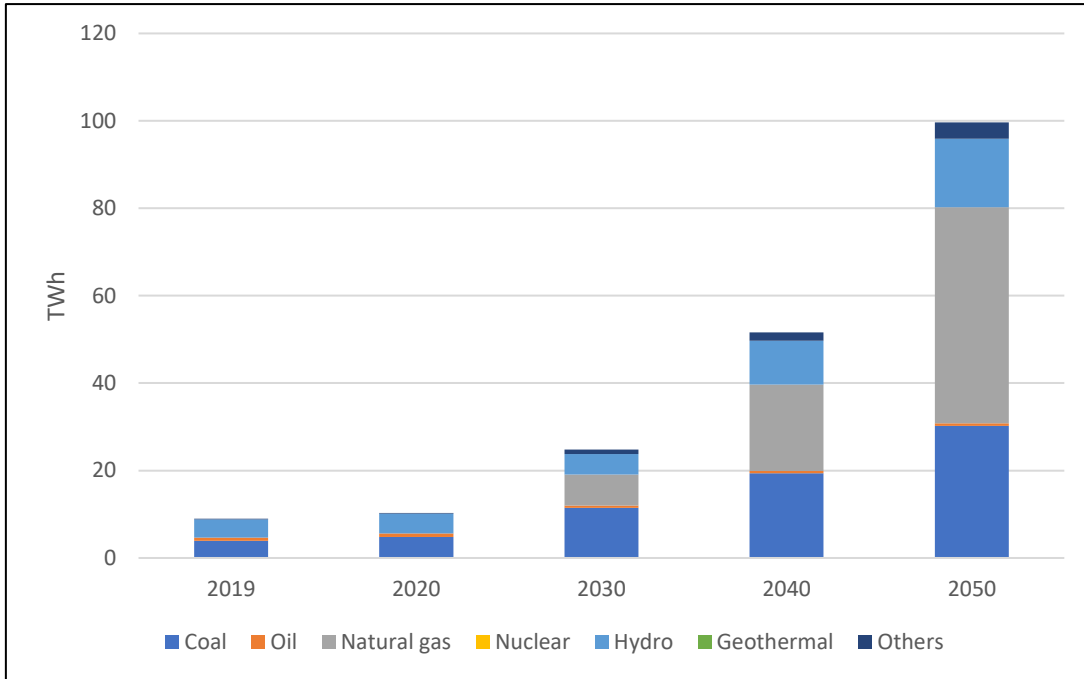
Source: Authors' calculation.

2.4. CO₂ emissions

CO_2 emissions from energy consumption are projected to increase by 6.6% per year from around 4 Mt-C in 2019 to 28 Mt-C in 2050 under BAU. Oil is the largest source of carbon emissions, which will increase faster at an average rate of 5.3% per year from 2.5 Mt-C in 2019 to 12.3 Mt-C in 2050. The second source of carbon emissions will be coal, with an average rate of 6.8% per year from 1.4 Mt-C in 2019 to 10.4 Mt-C in 2050 (Figure 5.5).

 The third source of carbon emissions will be natural gas, with the fastest average rate of 10% per year, from 0.7 Mt-C in 2027 to 5.2 Mt-C in 2050. Natural gas shows the highest carbon emission rate; however, the carbon emission amount will be less than half of oil and coal in 2050.

**Figure 5.5. CO$_2$ Emissions from Energy Consumption**
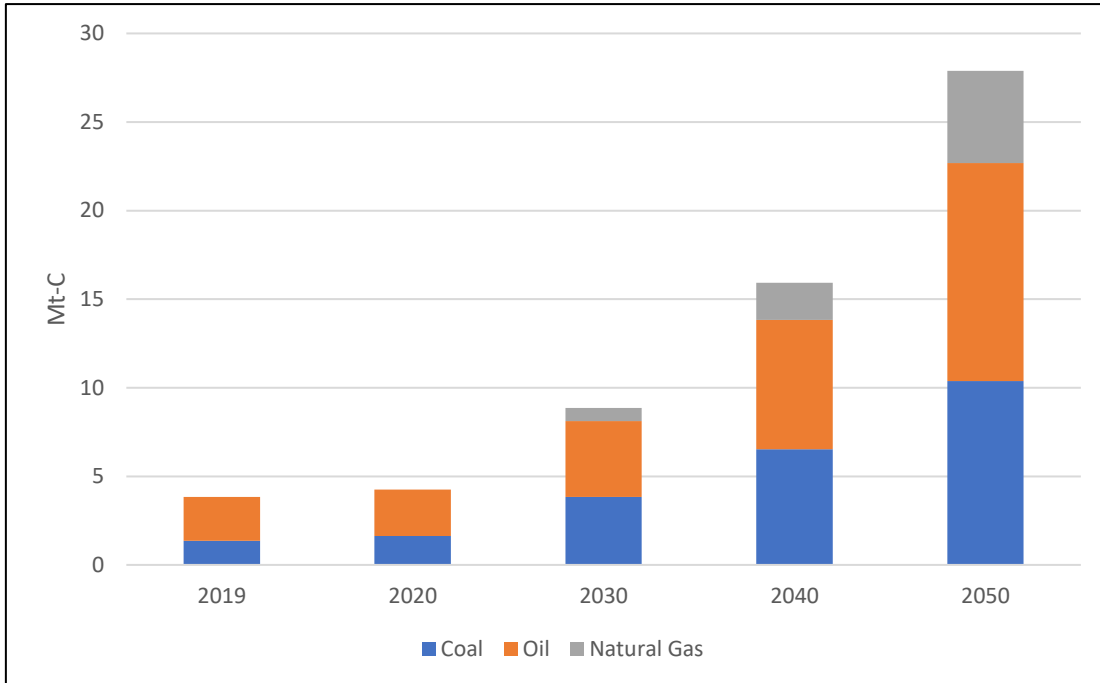
Source: Authors' calculation.

2.5. Energy indicators

Primary energy intensity was 343 toe/million US$ in 2019 and will decrease to 240 toe/million US$ in 2050. This indicates that energy will be used more efficiently in economic development as the country implements natural energy efficiency and conservation programmes. Another reason is biomass because its lower growth rate will press the TPES downward compared to the GDP.

Primary energy per capita will increase from 0.4 toe/person in 2019 to 1.4 toe/person in 2050, indicating that improving people's living standards and shifting to an integrated industry structure will increase energy demand per capita. Figure 5.6 shows various indicators for energy consumption and CO$_2$ emission.

Figure 5.6. Energy and CO₂ Indicators
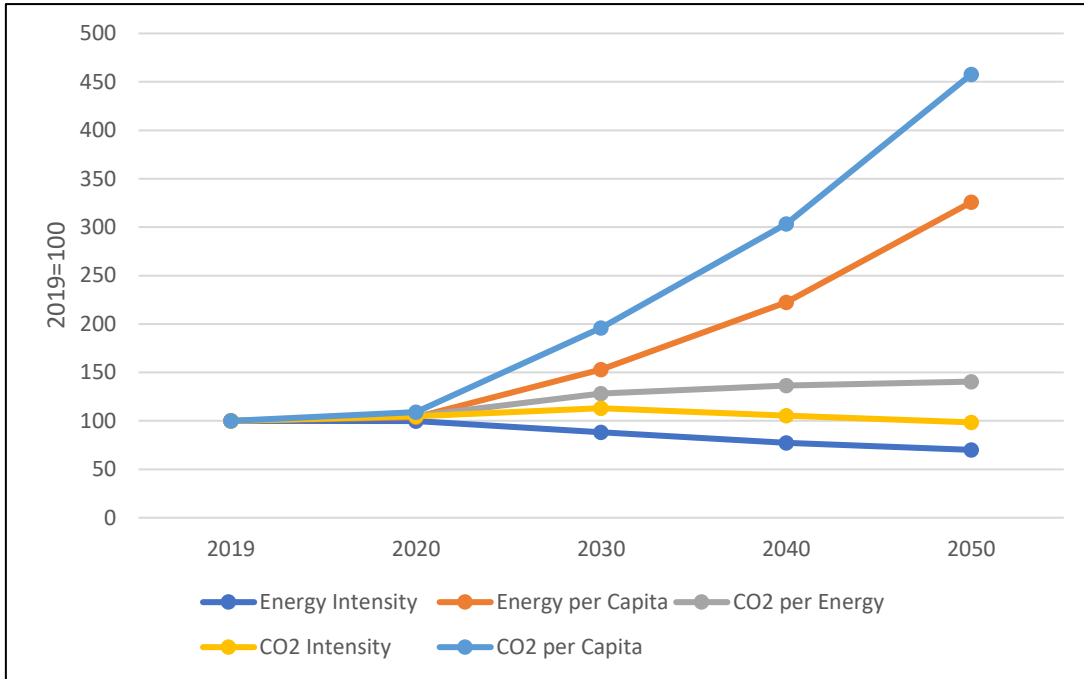
Source: Authors' calculation.

On CO_2 emission, the CO_2 per primary energy is projected to increase from 0.5 metric tonnes of carbon per tonne (t-C/toe) in 2019 to 0.8 t-C/toe in 2050, implying faster growth of fossil fuels in the total energy consumption. On the other hand, the CO_2 intensity will slightly decline from 184 t-C/million US$ in 2019 to 181 t-C/million US$ in 2050. This will change the power generation mix in 2019–2050 due to the rapid increase of gas power generation after 2027.